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(54) Title: A DESILTING APPARATUS FOR CLEANING A PRE-DEFINED VICINITY

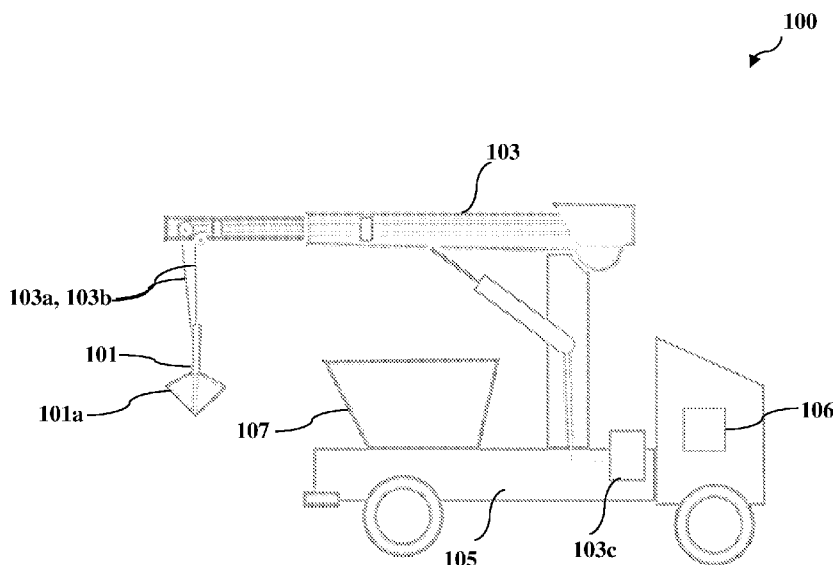


Figure 1

(57) Abstract: A desilting apparatus for cleaning a pre-defined vicinity [0036] The present invention relates to desilting apparatus (100) for cleaning a pre-defined vicinity. The apparatus (100) comprises an operating unit (106) and a 5 control unit (105) to monitor and actuate desilting operation executed through the apparatus (100) by an operator. A grasping device (101) cleans silt and debris accumulated in a predefined vicinity by employing one or more jaw buckets (101a) which grabs silt accumulated in the pre-defined vicinity. A hydraulic system (103c) performs the moving operation of hoist assembly (103) by transmitting power to 10 different components in the desilting apparatus (100). Further, the hoist assembly (103) comprises flexible members (104b) to freely maneuver the grasping device (101) within the pre-defined vicinity thereby collecting silt and debris from the pre-defined vicinity and transmitting silt into storage bin (107) provided at the desilting apparatus (100).



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A desilting apparatus for cleaning a pre-defined vicinity

5

PREAMBLE TO THE DESCRIPTION

[001] The following specification particularly describes the invention and the manner which it is to be performed:

DESCRIPTION OF THE INVENTION

10 Technical field of the invention

[002] The present invention relates to a desilting apparatus for cleaning a pre-defined vicinity by collecting silt and debris accumulated in the pre-defined vicinity. More particularly, the present invention relates to a system for automatic cleaning of silt and debris in a pre-defined vicinity by employing a grasping device.

15 Background of the invention

[003] Personal health and hygiene are interrelated, since personal hygiene plays an important role in maintaining a good quality of life and prevents an individual from acquiring various disease and illness. Even though environmental hygiene has the same adverse effect as that of personal hygiene on the well-being of a person,
20 the environmental hygiene is considered extraneous by a large number of people in the society. A recent study conducted by World Health Organization (WHO) revealed that globally, around 25 percent of diseases and 13 million deaths are caused due to exposure of the society to unhygienic environment. The sanitation related diseases cause approximately 4 lakh deaths annually, predominantly in
25 developing nations where the level of hygiene has degraded in recent years.

[004] A recent survey conducted in India reveals that around 70%, of the country's sewer systems are in dreadful conditions and at least one death of the sewer worker is recorded every five days, since the year 2017. Moreover, in developing countries, the maintenance and sanitization of sewer and drainage systems has deteriorated
30 over the years, since the cleaning process requires manual work which may be fatal

to the worker and requires high labor cost and work force. Further, cleaning of sewers and drainage systems manually by the designated workers does not yield efficient results. Despite the best efforts from different organizations to prevent manual operation of cleaning sewers and drainage systems which may have adverse health effects on the maintenance crew, there has been no significant result in providing an enhanced and automated cleaning operation of manhole basins and sewer systems.

[005] Over the years, the advancement of technology has been conducive for improving sanitization and cleaning operations which have improved cleaning solutions, in order to clean sewer systems. The contemporary cleaning methods comprises bucket machines that are most often used to clean a sewer manhole basin which removes accumulated debris and reinstates flow in sewer lines that cannot be eliminated by hydraulic cleaning techniques. The accumulation of the debris in a sewer manhole basin may be caused by large chunks of waste particles or due to the siltation process. The bucket-based machines are heavier than other manual tools, for example, a winch operated bucket which raises and lowers the bucket requires more equipment installation. The major disadvantage of these machines is that the bucket cannot reach or access all sides and corners of the sewer manhole basin, making this method usually ineffective and hazardous to remove the blockage and silt in the sewer manhole basin. The existing technologies for sewer and manhole desilting either require entry into the manhole by a human being that can be unsafe and unhygienic or use of manual tools that are time consuming and requires a lot of human effort or machine assistance. However, current mechanized solutions do not provide good maneuverability of the grab-bucket, and do not provide access to cleaning of the entire manhole basin. Consequently, many attempts have been made to create an automated cleaning solution to clean manholes and drainage systems with minimal maintenance, time and workforce.

[006] The Chinese Patent Application No. **CN108487441A** titled “A kind of manhole mud cleaning tool” relates to a kind of manhole mud cleaning tool which includes two handles, upper strut, interior bar, outer bar, lower supporting rod and so on. The left handle and right handles constitute a revolute pair with interior bar and two upper strut upper ends constitute revolute pair with left handle and right

handles respectively. There are three circumferential equally distributed branch bars for three forks. Further, the interior bar lower end is fastened with three forks and bucket valve is 1/6th ball planar. The upper end comprises two circular holes with one branch bar of circular hole and three forks on the lower end constitutes a revolute pair. The top circular hole constitutes a revolute pair with lower supporting rod lower end and three lower supporting rod upper ends constitute revolute pair with outer bar lower end. The Ball bushing is set between interior bar and outer bar whereas the outer bar upper and lower ends have sealing ring to be sealed with lateral surface which is equipped with anti-skid design. However, the manhole mud cleaning tool requires frequent intervention from the operator to bear the total load and to provide power to perform dredging operation.

[007] The Chinese Patent Application No. **CN201559947U** titled “*Grab bucket type garbage truck*” discloses a grab bucket type garbage truck, which has the characteristics of simple structure, convenient operation, small volume, flexibility, good operation performance, low use cost and diversified functions. The grab bucket type garbage truck comprises an automobile chassis, a grab bucket rotating suspension arm telescopic device assembly, a garbage compartment and a frame assembly. The frame assembly is fixed on the crossbeam of the automobile chassis, the middle of the frame assembly is provided with a grab bucket rotating telescopic suspension arm device, which can rotate relative to the frame, and the tail part of the frame assembly is provided with the garbage compartment. The grab bucket type garbage truck reduces the labor intensity of municipal landscaping and grounds-keeping workers, improves the working efficiency of the workers, ensures the operation safety of the working personnel, and is ideal equipment for clearing garbage and sewer sludge for city public sanitation departments. However, the reach of the grab bucket to perform dredging operation is limited due to the restricted arm length which prevents the grab bucket from cleaning corners of the sewer basin.

[008] Hence, there is a need for an advanced cleaning system to enhance the effectiveness of cleaning operation by automatically cleaning a predefined vicinity instantly with minimal maintenance and manual intervention.

Summary of the invention

[009] The present invention relates to a desilting apparatus for cleaning a pre-defined vicinity by automatically collecting silt and debris accumulated in the pre-defined vicinity. Further, the desilting apparatus comprises a grasping device to
5 clean silt and debris accumulated in the pre-defined vicinity, wherein the grasping device comprises one or more jaw buckets to dredge and grab silt accumulated in the pre-defined vicinity. The jaw bucket is clasped to the head of the grasping device with a plurality of variable sized linkages to allow maximum coverage area for the grasping device to accumulate silt. Furthermore, the desilting apparatus
10 comprises a hoist assembly to assist one or more kinetic motions of the desilting apparatus, wherein the hoist assembly comprises a hydraulic system to actuate kinetic motion by transmitting power to different components in the desilting apparatus.

[0010] Moreover, the hoist assembly comprises one or more coupling units to
15 freely maneuver the grasping device within the pre-defined vicinity, wherein the coupling unit 1 is penetrated through a hollow sleeve tube thereby connecting the frame of the grasping device to the hoist assembly. The coupling unit 2 is connected to an end arm provided at the periphery of the hollow sleeve tube thereby facilitating extension and dragging of the head of the jaw bucket to maneuver the
20 grasping device freely around the pre-defined vicinity for effective cleaning of silt and debris.

[0011] Further, the desilting apparatus comprises a storage bin to collect debris and silt accumulated from the pre-defined vicinity by the grasping device, wherein the storage bin comprises a shoveling plate and a perforated base to densely stack solid
25 silt in the storage bin and drain out liquid from the storage bin. The liquid from the storage bin is drained into a liquid storage compartment thereby providing access to an operator to drain silt liquid out from the liquid storage compartment when required.

[0012] Furthermore, the apparatus comprises a control unit which receives one or
30 more feedback signals from one or more sensors in the desilting apparatus and effectuates output signal to one or more components. Further, the apparatus

comprises an operating unit to monitor and regulate desilting operations of the apparatus executed by an operator, wherein the operator unit is connected to a control unit which actuates the desilting operation executed by the operator in the operating unit.

5 [0013] Thus, the present invention relates to a desilting apparatus for cleaning a pre-defined vicinity which provides automatic cleaning and accumulation of the silt and debris which is accumulated in a pre-defined vicinity through a grasping device. The coupling units in the hoist assembly maneuvers the grasping device as required by the operator thereby collecting silt and debris at different regions to clean a pre-
10 defined vicinity effectively and swiftly.

[0014] Further, the apparatus employed for sanitizing the pre-defined vicinity operates in optimal time without manual intervention, since the control unit in the desilting apparatus analyzes the amount of silt and debris accumulated in a pre-defined vicinity and transmits signals to the hoist assembly and the grasping device.

15 The present invention provides utility in public and residential sewer systems and manholes to clean silt and debris automatically which eliminates the need for manual intervention. Further, the present invention may be installed and retrofitted in the existing operating technology, for example the apparatus might be installed in the existing carrier van and other small vehicle transportation, thereby providing
20 mobile service in cleaning sewers and manholes.

Brief description of drawings

[0015] **FIG 1** illustrates a desilting apparatus for cleaning a pre-defined vicinity.

[0016] **FIG 2** illustrates a grasping device for cleaning silt and debris in a pre-defined vicinity.

25 [0017] **FIG 3, 3a and 3b** illustrates one more linkages connected in the grasping device.

[0018] **FIG 4** illustrates a sleeve tube provided in the grasping device.

[0019] **FIG 5** illustrates an embodiment of a support platform provided at a pre-defined vicinity.

Detailed description of the invention

[0020] Reference will now be made in detail to the description of the present subject matter, one or more examples of which are shown in figures. Each example is provided to explain the subject matter and not a limitation. Various changes and
5 modifications obvious to one skilled in the art to which the invention pertains are deemed to be within the spirit, scope and contemplation of the invention.

[0021] The present invention relates to a desilting apparatus for cleaning a pre-defined vicinity. The apparatus comprises an operating unit and a control unit to monitor and actuate desilting operations executed through the apparatus by an
10 operator. A grasping device cleans silt and debris accumulated in a pre-defined vicinity by employing one or more jaw buckets which grabs silt accumulated in the pre-defined vicinity. A hydraulic system performs moving operation of a hoist assembly by transmitting power to different components in the desilting apparatus. Further, the hoist assembly comprises one or more coupling units to freely
15 maneuver the grasping device within the pre-defined vicinity thereby collecting silt and debris from the pre-defined vicinity and transmitting silt into a storage bin provided at the desilting apparatus.

[0022] **Figure 1** illustrates a desilting apparatus (**100**) for cleaning a pre-defined vicinity. The apparatus (**100**) comprises a grasping device (**101**) provided at the
20 exterior end of the desilting apparatus (**100**) to clean silt and debris which are accumulated in a pre-defined vicinity, wherein the grasping device (**101**) comprises one or more jaw buckets (**101a**) to dredge and grab silt and debris through jaw shaped pans. In one embodiment, the apparatus (**100**) may be disposed in a mobility platform such as the carriage of a vehicle or a robotic unit which is employed to
25 clean silt and debris adhered at the basement of the sewer manhole basin. In another embodiment of the present invention, the grasping device (**101**) comprises a frame, wherein the frame comprises an actuator attached at the axis which may be powered through hydraulic, pneumatic or electric supply. Additionally, the actuator may be powered through a combination of either of a power supply, such as hydraulic and
30 pneumatic or pneumatic and electric supply or hydraulic and electric supply. Furthermore, one or more jaw buckets (**101a**) are hinged at the bottom of the frame, thereby operating opening and closing operation of the jaw buckets (**101a**). The jaw

bucket (101a) is clasped to the head of the grasping device (101) with a plurality of variably sized linkages to allow maximum coverage area for accumulating silt.

[0023] Figure 2 illustrates one embodiment of the present invention, wherein the grasping device (101) comprises at least three jaw buckets (101b) which are clasped to the head of the grasping device (101) through a pre-defined large sized linkages (102a) by using pins and fasteners at both ends of the grasping device (101). Moreover, the predefined small sized linkages (102b) are connected between the bottom of the frame and the surface of the bigger linkages (102) for enabling wide opening of the jaw buckets (101a) to cover maximum area for cleaning silt and debris from a pre-defined vicinity.

[0024] Figure 3 illustrates a desilting apparatus (100) comprising one or more linkages (102) which are connected between jaw buckets (101a) and the predefined small sized linkages (102b) through fasteners and clips. Figure 3a illustrates a grasping device (101) which comprises one of the jaw buckets (101a) connected to the predefined large sized linkage (102a) and the predefined small sized linkage (102b) at initial position. The ascending movement of the linkages (102), subsequent to the orientation of the large sized linkages (102a) expands the covering area of the jaw bucket (101a), as shown in Figure 3b. The linkages (102) augments grab capacity of the jaw bucket (101a) by incrementing the dredging action to accumulate silt and debris at a pre-defined vicinity.

[0025] Furthermore, the desilting apparatus (100) comprises a hoist assembly (103) to assist one or more kinetic motions of the desilting apparatus (100), wherein the hoist assembly (103) provides mast and boom to support the transmission of the grasping device (101). Further, power lines and hoist motor are established for performing the extension and contraction operation of the supporting structure in the grasping device (101). The hoist assembly (103) comprises a hydraulic system (103c) that perform to actuate kinetic motion by transmitting power to different components in the desilting apparatus (100). In one embodiment the hydraulic system (103c) comprises one or more hydraulic cylinders provided at the horizontal and vertical surface of the hoist assembly (103), thereby extending the horizontal surface as per the requirement of the operator.

[0026] Furthermore, the hoist assembly (103) comprises one or more coupling units (103a, 103b) to freely maneuver the grasping device (101) within the pre-defined vicinity, for example, the grasping device (101) may maneuver freely within the sewer manhole basin. The coupling units (103a, 103b) may be in the form of flexible cables or rigid cables to control unconfined maneuverability of the grasping device (101) by extending and pulling the head of the jaw bucket (101a) to maneuver the grasping device (101) freely around the pre-defined vicinity. In one embodiment of the present invention, the coupling unit (103a, 103b) is equipped with the provision of the flexible coupling unit (103a, 103b) and the rigid coupling unit (103a, 103b) to connect the grasping device (101) to a mobility platform, wherein the grasping device (101) may be controlled manually or automatically or in semi-automated mode.

[0027] Further, the grasping device (101) comprises a sleeve tube (104) which may be in the form of rigid tubes or hollow tubes to connect the head of the jaw bucket (101a) with the hoist assembly (103). In one embodiment, two coupling units (103a, 103b) which may be either the flexible or the rigid cables are extended from the hoist motor and traversed through two end pulleys provided at the horizontal surface of the hoist assembly (103). The coupling unit 1 (103a) is penetrated through a hollow sleeve tube (104) provided in the frame of the grasping device (101) and the coupling unit 2 (103b) is connected to an end arm provided at the periphery of the hollow sleeve tube (104) connecting a frame of the grasping device (101) thereby enabling grasping device (101) to maneuver freely around the pre-defined vicinity. In another embodiment, the coupling unit (103a, 103b) may use a combination of rigid cable and flexible cable to maneuver the grasping device (101), wherein the part of the coupling unit (103a, 103b) traversing from the grasping device (101) may be rigid, which is subsequently connected to the flexible cable.

[0028] The desilting apparatus (100) comprises a control unit (105) for actuating the desilting operation in the predefined vicinity, wherein the control unit (105) effectuates output signal to one or more components in the desilting apparatus (100). Moreover, the control unit (105) receives one or more feedback signals from one or more sensors in the desilting apparatus (100), for example, the control unit

(102) receives signals from sensors provided at the hydraulic motors, hydraulic cylinders and grasping device (101), wherein the sensor in the grasping device (101) may be a camera unit. In another embodiment, the control unit (105) generates a signal which is transmitted to a hydraulic fluid reservoir, actuators and pressure valves for performing desilting operation in a pre-defined vicinity. In one
5 embodiment, the fluid is pumped from the hydraulic fluid reservoir to the hydraulic cylinder and the hydraulic motor which is monitored by the control unit (105) and regulated by the pressure valve.

[0029] Further, the apparatus (100) comprises an operating unit (106) connected to
10 an control unit (105) to monitor and regulate the desilting operation of the apparatus (100) by an operator, wherein the operating unit (106) may comprise an electronic processing unit provided at an operator compartment which may be in the passengers compartment of the vehicle or at a predetermined distance away from the apparatus (100). In another embodiment, the orientation of the grasping device
15 (101) and the position of the hoist assembly (103) are adjusted automatically by the control unit (105) which eliminates the need for an operator during desilting operation. In another embodiment, the operating unit (106) may be accessed by one or more operators to position the hoist assembly (103) and adjust the orientation of the grasping device (101) during desilting operation. Additionally, the desilting
20 operation may be performed in a semiautomatic mode by the operator and the control unit (105).

[0030] **Figure 4** illustrates an embodiment, wherein the grasping device (101) comprises a plurality of rollers implanted within the sleeve tube (104) for frictionless movement of the coupling units (103a, 103b) thereby connecting the
25 frame of the grasping device (101). The coupling unit 2 (103b) is connected to an end arm provided at the periphery of the hollow sleeve tube (104) thereby facilitating extension and dragging of the head of the jaw bucket (101a), wherein one end of the hollow sleeve tube (104) is attached to a supporting platform forming a revolute pair to maneuver the grasping device (101) freely around the pre-defined vicinity. In one embodiment, the coupling units (103a, 103b) comprises fluid line
30 which is housed within the load bearing casing. In another embodiment, the fluid line and the load bearing casing are juxtaposed for improved stability.

[0031] Furthermore, the desilting apparatus (100) comprises a storage bin (107) to collect debris and silt accumulated from a pre-defined vicinity by the grasping device (101). The storage bin (107) comprises a shoveling plate to densely stack solid silt in the storage bin (107) by compressing the silt collected in the storage bin (107). Furthermore, the storage bin (107) comprises a perforated base to drain out liquid from the storage bin (107) into a liquid storage compartment thereby providing access to an operator to drain the liquid when required. **Figure 5** illustrates an embodiment of the desilting apparatus (100), wherein a support platform (108) is provided to deposit the grasping device (101) through the central hole of the support platform (108) for cleaning the silt and debris at the pre-defined vicinity.

[0032] In one embodiment of the present invention, the desilting apparatus (100) executes desilting operation by removing the manhole basin lid, thereby placing the support platform (108) at the periphery of the manhole lid. Further, the desilting apparatus (100) is placed in proximity of the manhole basin, thereby extending the hoist assembly (103) and descending the sleeve of the grasping device (101) into the manhole basing by employing two coupling units (103a, 103b). A hook is provided in the desilting apparatus (100) to endure the grasping device (101) at the support platform (108) thereby positioning the grasping device (101) within the sewer manhole basin. Further, one or more coupling units (103a, 103b) are altered to maneuver and position the jaw bucket (101a) within the sewer manhole basin as required by the operator. The jaw bucket (101a) collects silt and debris accumulated in the manhole base thereby unhooking the sleeve from the support platform (108). The grasping device (101) is ascended from the manhole basin subsequent to the collection of silt and debris and the lid is enclosed. Furthermore, the silt material is stored into the storage bin (107) of the desilting apparatus (100). In another embodiment of the present invention, a combination of grasping devices (101) may be used, such as, a three-bucket and sleeve guided grabber.

[0033] Thus, the present invention relates to a desilting apparatus (100) for cleaning a pre-defined vicinity which provides automatic cleansing and collection of the silt and debris accumulated in a pre-defined vicinity through a grasping device (101). The coupling units (103a, 103b) in the hoist assembly (103) improves the efficiency

of desilting operation, since the coupling units (**103a**, **103b**) automatically maneuvers the grasping device (**101**) as required by the operator thereby by collecting silt and debris at different regions to clean a pre-defined vicinity effectively and swiftly.

5 **[0034]** Further, the apparatus (**100**) employed for sanitizing the pre-defined vicinity operates in optimal time without the manual intervention, since the control unit (**105**) in the desilting apparatus (**100**) analyzes the amount of silt and debris accumulated in a pre-defined vicinity and transmits signals to the hoist assembly (**103**) and the grasping device (**101**). The present invention provides utility in public
10 and residential sewage systems and manholes to clean silt and debris automatically which eliminates the need for manual intervention. Further, the present invention may be installed and retrofitted in the existing operating technology, for example the apparatus (**100**) might be installed in the existing carrier van and other small vehicle transportation, thereby providing mobile service in cleaning sewages and
15 manholes.

[0035] The features and advantages of the invention are apparent from the detailed specification, and thus, it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true spirit and scope of the invention. Further, since numerous modifications and variations will readily
20 occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

Reference numbers:

Components	Reference Numbers
Apparatus	100
Grasping device	101
Jaw buckets	101a
Three jaw buckets	101b
Linkages	102
Pre-defined large sized linkages	102a
Pre-defined small sized linkages	102b
Hoist assembly	103
Coupling units	103a, 103b
Hydraulic system	103c
Sleeve tube	104
Control unit	105
Operating unit	106
Storage bin	107
Support platform	108

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Claims:

We claim:

1. A desilting apparatus (**100**) for cleaning a pre-defined vicinity, wherein the apparatus (**100**) comprising:
 - 5 a. a grasping device (**101**) to clean silt and debris accumulated in a pre-defined vicinity, wherein the grasping device (**101**) comprises one or more jaw buckets (**101a**) to dredge and grab silt accumulated in the pre-defined vicinity;
 - 10 b. one or more linkages (**102**) connected between jaw buckets (**101a**) and pre-defined small sized linkages (**102b**) to augment grab capacity of the jaw bucket (**101a**) by expanding the covering area of the jaw bucket (**101a**);
 - 15 c. a hoist assembly (**103**) linked to the grasping device (**101**) to assist one or more kinetic motions of the desilting apparatus (**100**), wherein the hoist assembly (**103**) comprises one or more coupling units (**103a**, **103b**) to freely maneuver the grasping device (**101**) within the pre-defined vicinity .
- 20 2. The apparatus (**100**) as claimed in claim 1, wherein the grasping device (**101**) comprises a sleeve tube (**104**) with the discretion of rigid and hollow sleeve tubes (**104**) to connect the head of the jaw bucket (**101a**) with the hoist assembly (**103**).
- 25 3. The apparatus (**100**) as claimed in claim 1, wherein the coupling unit 1 (**103a**) is penetrated through a hollow sleeve tube (**104**) and the coupling unit 2 (**103b**) is connected to an end arm provided at the periphery of the hollow sleeve tube (**104**) connecting a frame of the grasping device (**101**).
- 30 4. The apparatus (**100**) as claimed in claim 1, wherein the coupling units (**103a**, **103b**) control unconfined maneuverability of the grasping device (**101**) by facilitating extension and dragging of the head of the jaw bucket (**101a**) to maneuver the grasping device (**101**) freely around the pre-defined vicinity.

5. The apparatus (100) as claimed in claim 1, wherein the coupling unit (103a, 103b) is equipped with the provision of the flexible coupling unit (103a, 103b) and the rigid coupling unit (103a, 103b) to connect the grasping device (101) to a mobility platform.
- 5
6. The apparatus (100) as claimed in claim 1, wherein the jaw bucket (101a) is clasped to the head of the grasping device (101) with a plurality of variable sized linkages to allow maximum coverage area for accumulating silt.
- 10
7. The apparatus (100) as claimed in claim 1, wherein the apparatus (100) comprises a control unit (105) for actuating the desilting operation in the predefined vicinity, wherein the control unit (105) effectuates output signal to one or more components in the desilting apparatus (100).
- 15
8. The apparatus (100) as claimed in claim 1, wherein the apparatus (100) comprises an operating unit (106) connected to a control unit (105) for monitoring and regulating desilting operation of the apparatus (100) by an operator.
- 20
9. The apparatus (100) as claimed in claim 1, wherein the desilting apparatus (100) comprises a storage bin (107) to collect debris and silt accumulated from the pre-defined vicinity by the grasping device (101).
- 25
10. The apparatus (100) as claimed in claim 1, wherein the storage bin (107) comprises a shoveling plate and a perforated base to densely stack solid silt in the storage bin (107) and drain out liquid from the storage bin (107).
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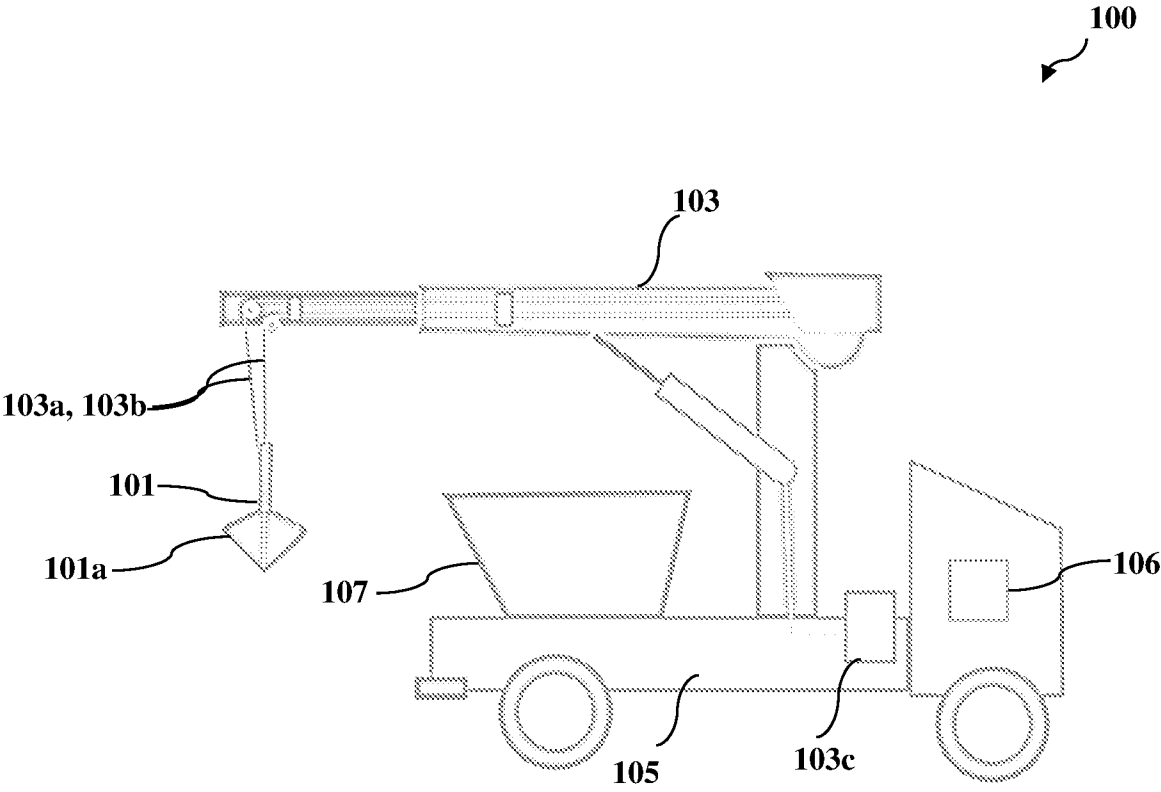


Figure 1

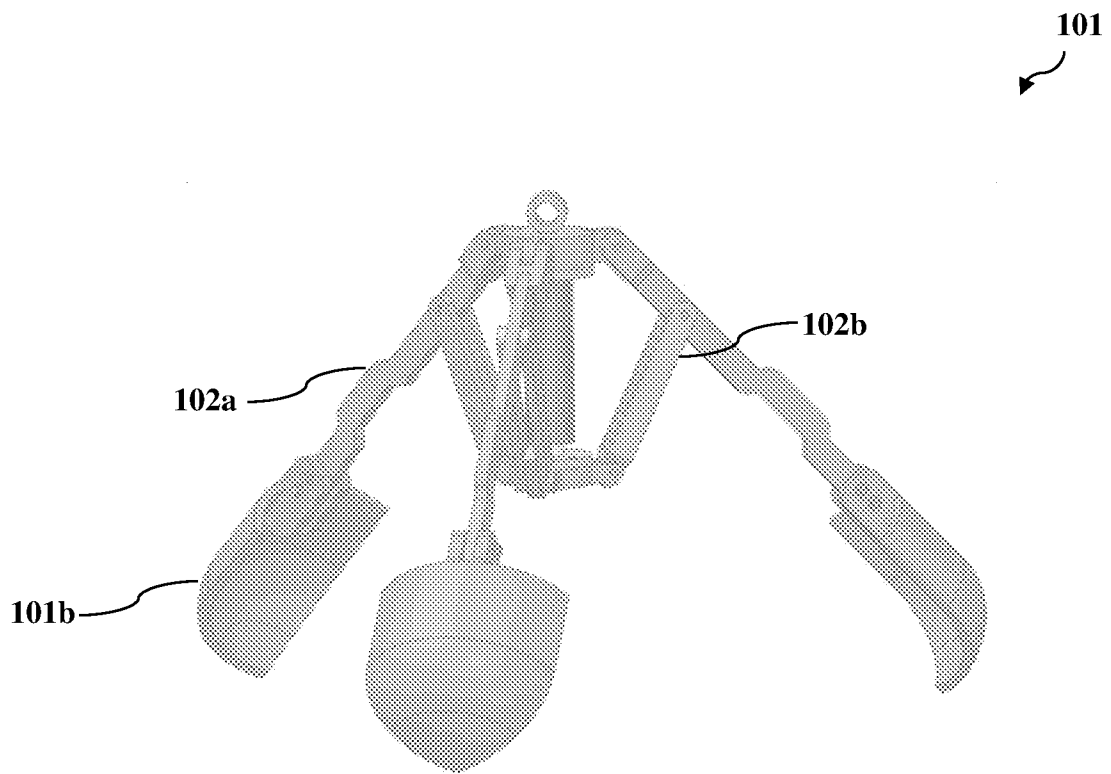


Figure 2

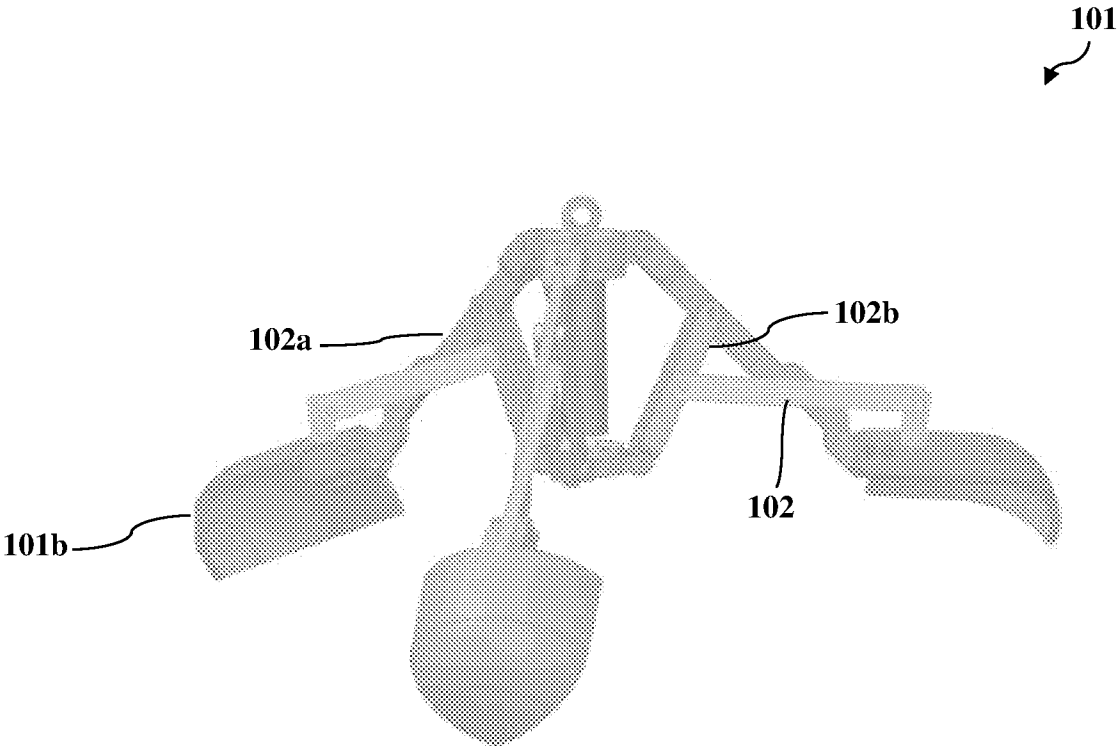


Figure 3

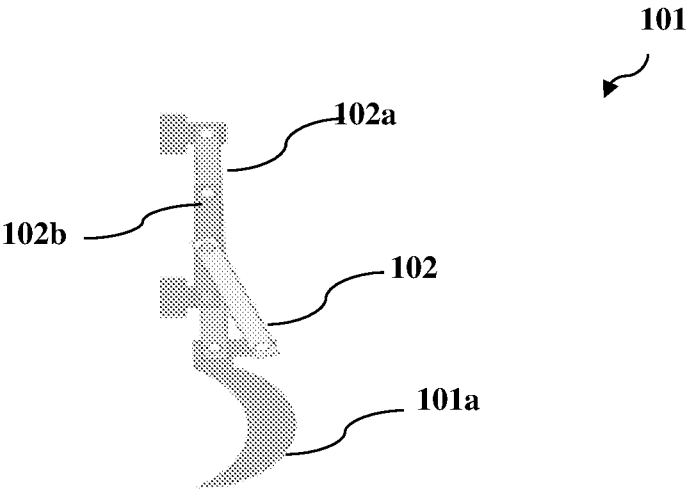


Figure 3a

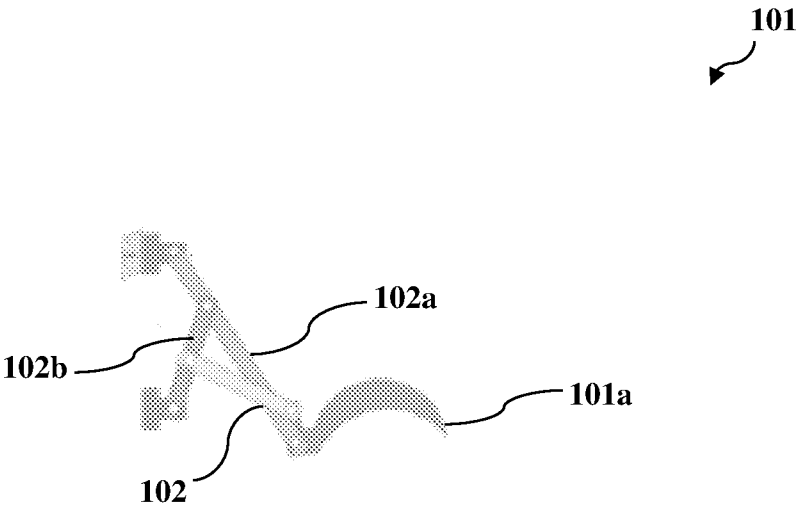


Figure 3b

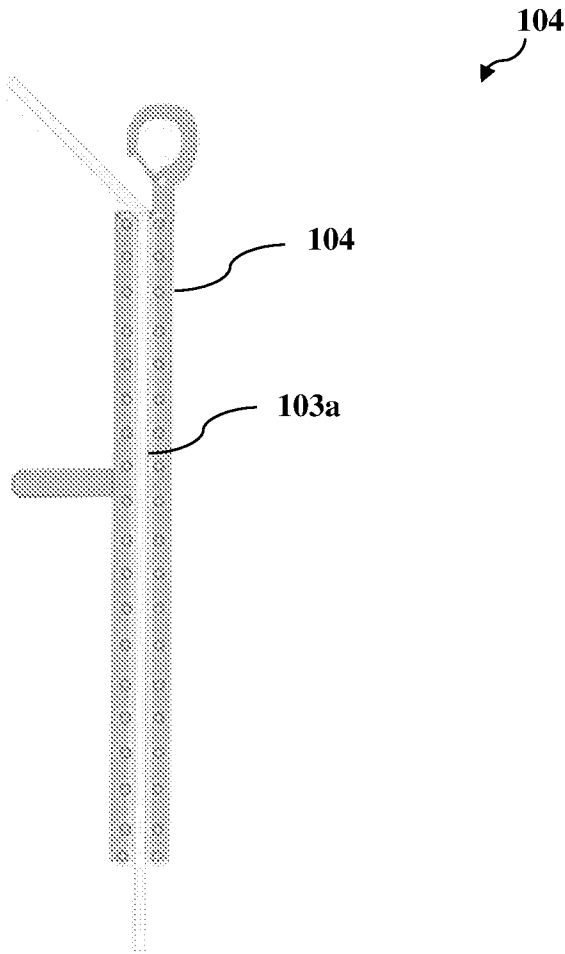


Figure 4

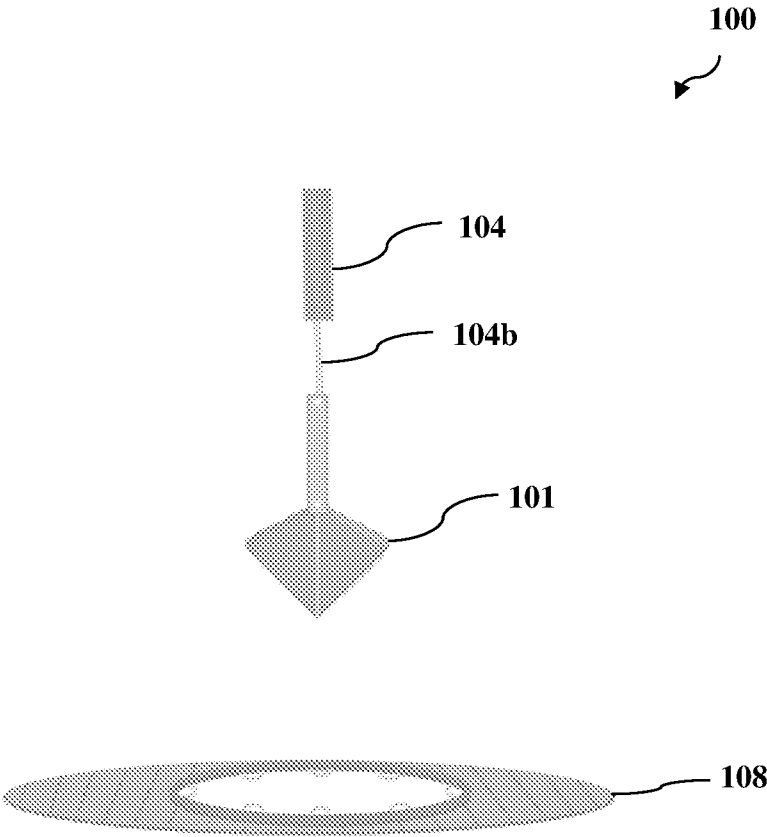


Figure 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2020/053151

A. CLASSIFICATION OF SUBJECT MATTER
E02F3/46, E02F3/60 Version=2020.01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

TotalPatent One, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN1519434A (YAO SHIXIAN) 11 August 2004 (11.08.2004) description para 9,10,22,35,42,47,78 & 109 as per English translation of Espacenet; figure 1,1.1,3,2.2; -----	1-10
Y	CN202899184U (WUHU BOBCAT ENGINEERING MACHINERY CO LTD) 24 April 2013 (24.04.2013) Abstract;claim1-2;figure 2,6; -----	1-10
Y	CN102628290B (ZOOMLION HEAVY INDUSTRY SCIENCE & TECHNOLOGY DEVELOPMENT CO., LTD.) 24 December 2014 (24.12.2014) see description para 7,22 as per English translation of Espacenet; -----	7-8
Y	WO2016201685A1 (LIU HUIHE) 22 December 2016 (22.12.2016) abstract; see description para 13 as per English translation of Google Patents; figure 1; -----	4-6, 9-10
A	KR101339890B1 (SHIN MYEONG CONSTRUCTION ENGINEERING CO LTD) 10 December 2013 (10.12.2013) whole document;	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

14-08-2020

Date of mailing of the international search report

14-08-2020

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2020/053151

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2020/053151

Citation	Pub.Date	Family	Pub.Date
CN 102628290 B	24-12-2014	CN 102628290 A	08-08-2012
KR 101339890 B1	10-12-2013	KR 20130052889 A	23-05-2013